

# **Fast, Low-Cost Missions to the Outer Solar System**

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Miniature, low-cost, highly autonomous spacecraft can enable greatly expanded exploration of the outer solar system with frequent missions and low life-cycle costs. Flyby missions with relatively short flight times appear possible with small launch vehicles and appropriate upper stages. Direct flights to Jupiter and Saturn can take as little as 1-2 years, and flights to Uranus, Neptune, and Pluto can take only 6-10 years. With the addition of a Jupiter gravity assist, it appears possible to further reduce the Uranus, Neptune, and Pluto flight times to a range of 4-7 years. The approach to the new generation of spacecraft envisioned for these missions includes reducing spacecraft resource requirements, complexity, size, and mass; eliminating non-cost-effective redundancy; using extensive autonomy; and expanding production through use of high-level building blocks. The paper expands further on these areas while describing a specific concept for a spacecraft that is less than 0.5 m diameter and 10 kg. System and subsystem descriptions, power and mass summaries, an example operation scenario, and technology needs are included.